NGST Operational Concept Document: Interim Review

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NGST Operations Concept Team

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NGST Operational Concept Document

- The NGST Operational Concept Document is a document that will be used to support the definition, development and maintenance of the NGST Mission
  - Observatory
    - Hardware Architecture
    - Flight Software
  - Ground System
- The document will be updated for or following key phases of the NGST project, such as Prime Contractor selection and System Requirements Review.
- The document will be maintained for the duration of the NGST mission.

Purpose Of The Interim Review

- The purpose of this review is to describe the following:
  - Format and content of the Operational Concept Document
  - Status of process for generating the document
  - Status of key issues
    - Description of issues
    - Assumptions
    - Recommended approach
    - Trades
    - Remaining issues
  - Process and schedule for next version of the document

Format And Content Of The Operational Concept Document

Format And Content (cont)

- Contents will be mid-level.
  - Detailed discussions will be maintained in special reports.
  - The Operational Concept Document will summarize and reference these special reports.

Current Status Of Process For Generating The Document

- Reviewed previous and draft documents
  - "NGST Yardstick Mission - Monograph 1"
  - "System Level Requirements, Recommendations and Guidelines - Monograph 5"
  - "NGST Operations Concept Interim Report",24 Jan 2000
  - "NGST Operations Concept Studies: Low-Cost Operations"
  - "NGST Week-in-Life Operations Scenarios - Draft"
  - "Science Drivers for NGST Small-Angle Maneuvers"
  - "Guiding and Acquisition with NIRCAM" Report
  - "NGST Event-Driven OPE System" Presentation Viewgraphs
  - "NGST Integrated Ground/Flight Software Operations Concept"

Status Of Process (cont)

- Collated reference material into Table of Contents
- Identified key issues
  - From review of Week-in-Life Operations Scenarios
  - From review of Operational Concept Document Table of Contents
- Several topics were identified for special studies by NGST division
  - Calibration - draft
  - Orientation constraints - viewgraph presentation
  - Parallels - draft viewgraph presentation
  - Observing strategies - pending
  - Operations modes - pending
  - Data processing - draft viewgraph presentation

Key Issues Discussion

- Telemetry - Mary Alice
- Anomalies and Exceptions - Vicki
- Optical Calibration (Wave Front Sensing and Control) - Ray
- Parallel Calibration - Perry
- Observation Planning Process - Carl
- Guide Star Acquisition / Catalog - Harry
- Integration and Test - John

Telemetry

Telemetry

- Topic
  - What are the philosophy and approach for handling engineering telemetry data?
  - What are the implications for spacecraft C&DH and ground processing?
- Additional Issues
  - Can we apply lessons learned from HST for handling engineering telemetry data?
    - The snapshots downlinked with HST data have not always provided adequate information for some types of calibration or analysis
    - Access to the complete engineering stream (all points) or multiple snapshots are required for algorithms that need the integration of certain parameters over a given period
    - The required parameter set changes as we gain experience with the instrument
  - What is the best way to associate engineering data with science data on the ground?

Telemetry (cont.)

- Assumptions
  - The ground system has access to the engineering data (engineering stream and event log) when the science data is ready for processing
    - Engineering data transmitted before science data via reliable communications link
    - Engineering data given precedence over science data on on-board recorders (write over science data first on overflow)
    - Science observations will cease if the engineering data buffer overflows
  - There is a single master clock on board the spacecraft to synch the science with the engineering data
  - Each engineering parameter needed by the pipeline software will be sampled at a frequency sufficient for the ground system to accurately process the science data

Telemetry (cont.)

- Proposed Approach
  - Science pipeline processing will cull the parameters it needs from an engineering database
    - The engineering data stream will need to be downlinked and analyzed for routine monitoring of the spacecraft anyway; additional processing to make this data available for the science pipeline will not significantly increase the complexity of the ground system.
    - No engineering snapshots will be taken with the science data
    - The interface between the engineering data pipeline and the science data pipeline will be well-defined and flexible to facilitate changes
  - FSW will create internal headers in the science data which contain identification parameters to enable the ground system to sort the exposures

Telemetry (cont.)

- Approach (cont.)
  - Science And Engineering Data Archive
    - The ground system will include an archive of level 0 or 1 science and engineering data
    - Processing will be done "on demand" by the ground system for:
      - spacecraft monitoring
      - science and engineering data production
      - routine queries, data analysis, and retrievals
      - reprocessing

Telemetry (cont.)

- Approach (cont.)
  - Engineering Parameter Data Dictionary
    - All spacecraft and instrument engineering parameters (all points, including derived parameters) will be defined in a database as follows:
      - a clear definition of what the parameter is
      - how to interpret its effect on health and safety of the spacecraft, if/when known
      - what the consequences are if limits are exceeded, if/when known
      - what derived/pseudo mnemonics are affected by it
      - what its minimum update rate is

Telemetry (cont.)

- Trades
  - Advantages
    - We will not need to develop FSW to produce engineering snapshots.
    - Changing the telemetry items needed for data processing will not require a FSW change.
    - There is a single source for conversion/reduction/calibration algorithms.
    - This is consistent with the direction we're moving for HST (OTFC/R and the engineering data warehouse).
    - The engineering data dictionary will facilitate (a)communication, (b) development and maintenance of the ground and FSW systems, and (c) operations and user support.
  - Disadvantages
    - If some engineering data is lost, then the ground system will need to fall back to some TBD assumptions (e.g., using planning info) in order to process the science data.

Telemetry

Guide Star Data Volume and Downlink

- Topic
  - Do we need guide star image data on the ground?
- Additional Issues
  - What is the data volume?
  - What will the data be used for?
- Approach
  - Guide star data will be downlinked as a separate file, following the transmission of the event logs, engineering data, and science data
    - high-rate guide star data is approximately equal to 1/64 of the science data
    - the frequency of capture and transmission will be tunable
    - some anomaly investigations will be impossible without the images
    - the data may be useful for PSF calculations

NGST Anomalies and Exceptions

NGST Anomalies and Exceptions

- Topic
  - Provide unified concept for NGST spacecraft anomaly management
- Issues
  - How can the different flight software components handle anomalies and exceptions in a consistent manner?
  - How and when will the ground receive notification of anomalies/exceptions?
  - How will the ground respond to anomaly/exception notification?

NGST Anomalies and Exceptions

- Assumptions
  - All the necessary health and safety monitors will be on-board
  - Fsw/hw reactions will be completed before damage occurs
  - Communication contacts with NGST will occur at nighttime
  - Ground staff response will occur during the daytime
  - The maximum radiation rate from solar events will be below the danger limit of any spacecraft component.

NGST Anomalies and Exceptions (cont)

- Proposed Approach
  - Flight Software will monitor hardware/software
  - Lowest possible routines will notify central error handler when anomaly occurs
  - Error handler will log each anomaly and will request associated response
    - Exception log will contain information about anomaly occurrence
    - Activity event log will report the reaction of observation plan execution system (OPE)
  - All anomaly responses are easily modifiable by ground.

NGST Anomalies and Exceptions (cont)

- Approach (cont)
  - Response examples:
    - Request spacecraft safing
    - Request SI safing
    - Request hardware unit power off
    - Notify OPE
    - Output message to exception log
  - Logs will be dumped at start of every communications contact and at times during each contact
  - Ground software will quickly analyze the logs and will electronically report anomalies to affected ground subsystems

NGST Anomalies and Exceptions (cont)

- Approach(cont)
  - Appropriate ground staff will receive notification of anomalies and after they complete their analysis, they will plan recovery procedure
  - At next available contact, uplink revised observation plan containing recovery activities
  - Standard ground response time = 1-2 days
  - Visit failure review board will decide scheduling option for each lost visit

NGST Anomalies and Exceptions (cont)

- Anomaly/Response Examples:
  - 1. Guide Star/Target Acquisition Failures
    - Gsacq/SI fsw will notify error handler that no guide star(s)/target star(s) found
    - Error handler will log gsacq/tacq failure and send notification to OPE
    - OPE will jump to next planned visit and make entry in activity event log
    - After activity event log dump, ground subsystems will analyze failure
    - Visit failure review board will decide scheduling option for lost visit

NGST Anomalies and Exceptions

- Anomaly/Response Examples:
  - 2. Science Instrument Safing
    - SI fsw will notify error handler that SI hardware limit violation has occurred
    - Error handler will log violation, request SI safing and send notification to OPE
    - OPE will reject any further activity requests for affected SI (including gsacq and dithers if SI is prime) and make entry in activity event log
      - note slews will continue to ensure legal attitude maintained
    - Ground subsystems will analyze violation and plan recover of SI
    - Revise observation plan uplinked to spacecraft at next available contact

NGST Anomalies and Exceptions (cont)

- Anomaly/Response Examples:
  - 3. Spacecraft Safing
    - FSW will notify error handler that dangerous situation has occurred
    - Error handler will log violation and request spacecraft safing
    - History buffers, collected science and engineering data will be preserved for later dumping
    - After activity event log dump, ground subsystems will analyze failure
    - Revised observation plan uplinked to spacecraft at next available contact
    - Visit failure review board will decide scheduling option for lost visits

NGST Anomalies and Exceptions (cont)

- Remaining Issues:
  - What to do when solar events occur?
    - Two options:
      - A. Do nothing, continue observing
        - Sort out affected visits on the ground
        - Visit failure review board will decide scheduling option for lost visits
      - B. Have radiation monitor onboard and suspend SI data taking when radiation reaches rate that impacts science
        - FSW will notify error handler that radiation threshold violated
        - Error handler will log violation and will send notification to OPE
        - OPE will reject any further activity requests for affected SI (including gsacqs and dithers if SI is prime) and make entry in activity event log (will continue to slew to ensure legal attitude)

Optical Calibration

(Wavefront Sensing & Control)

Optical Calibration (Wave Front Sensing & Control)

- Topic
  - Determine what, if any, unique ground or flight systems capabilities are required by Wavefront Sensing & Control (WFSC) operations
- Additional Issues
  - Differences between WFSC operations and normal science operations must be minimized in order to reduce development and operations costs
  - Real-time operations are costly and inefficient and should be avoided whenever possible

Optical Calibration (cont)

- Assumptions
  - All initial WFSC operations are essentially a pattern of mechanism motions, each motion followed by NIR camera images
    - Images for each stage of the initial calibration can be downlinked and analyzed as a group
  - Wavefront quality during normal operations will be stable over a one to three month timeframe and be independent of spacecraft attitude
  - Updates to the wavefront actuators during normal operations will not degrade the wavefront quality
    - Real-time verification of the update is not necessary before proceeding with the observation plan

Optical Calibration (cont)

- Proposed Approach
  - WFSC operations will use the same telescope command and telemetry interfaces used by normal science operations
  - WF sensing (observations to measure the wavefront) and WF control (updates to mechanism positions) will be constructed as separate visits, uplinked in an observation plan and processed by the Observation Plan Executive (OPE) in the ISIM
  - NIR camera images taken during WFSC visits will be managed onboard, downlinked and processed on the ground in exactly the same way as normal science observations
    - The processed science images will be identified for WF analysis via proposal ID

Optical Calibration (cont)

- Approach **during initial WFSC operations**
  - Uplink and execution of observation plans with WFSC visits will only be performed while the ground is in communications contact with the telescope (there may be continuous communications coverage during this early phase of the mission)
  - A WFSC visit will consist of a series of requests for mechanism motion, most of which will be followed by one or more NIR camera images
  - Separate observation plans will be created for each stage of the initial WFSC operations
  - OPE will pause when the end of a WFSC observation plan is reached, waiting for the next plan to be uplinked from the ground

Optical Calibration (cont)

- Approach **<u>during normal operations</u>**
  - WF sensing visits (if routine guide star or science data is not adequate) and WF control visits (to move WF actuators to their corrected positions) will be scheduled in the same manner as routine calibration visits
  - The potential need for routine WF sensing visits will decrease telescope observing efficiency but will not complicate ground system design
  - The baseline frequency of WF updates (one to three months) will allow WF control visits to be incorporated into an observation plan after the corrected actuator positions have been determined

Optical Calibration (cont)

- Remaining Issues
  - The method of measuring the wavefront quality during normal operations is TBD
    - May be able to use guide stars or NIR science images or may require dedicated wavefront sensing observations
  - WF control visits during normal operations may impose additional requirements on planning process if WF updates are required more frequently than once per month
    - Replan the currently executing observation plan with the WF control visit included

      or
    - Uplink the corrected actuator positions as parameters to a pre-planned WF control visit

Parallel SI Calibration

Parallel SI Calibration

- Topic
  - Can we increase observatory efficiency with parallel SI calibrations?
- Additional Issues
  - Uncertainty of detector calibration requirements.
    - Instrument performance not well understood until after launch (stability and type of calibrations).
    - Darks may depend on many factors or change rapidly
  - To what degree do instruments and mechanisms interact - electrical interference and vibration
    - Parallel mechanism motions and parallel data readouts
  - Cost of parallel observations capability in telescope/instrument design.
  - Cost of supporting parallel calibrations in operations.

Parallel SI Calibration (cont)

- Assumptions
  - It will not be possible to use internal lamps in parallel.
  - It will be possible to perform the following calibrations in parallel:
    - Darks
    - Sky flats
    - PSF
  - Reference architecture implies a capability for some parallel instrument operation:
    - Using the NIRCAM for guiding during NIRSPEC and MIR observations
    - Using all four NIRCAM modules.

Parallel SI Calibration (cont)

- Proposed Approach
  - Support parallel SI calibrations for darks and sky flats.
  - Parallel SI calibrations will be conducted by the STScI instrument groups.

Parallel SI Calibration (cont)

- Trades
  - Advantages
    - Mitigates risk of inefficient spacecraft operations
      - Experience gained in-flight may require large volume of calibration data
    - Parallel observations allow ability to carry out diagnostic monitoring simultaneously with science data taking
  - Disadvantages
    - Cost to implement parallel SI calibrations

Parallel SI Calibration (cont)

- Remaining Issues
  - More work on efficiency assessment is needed.
  - More work on risk assessment is needed
  - Detailed estimate of the relevant costs is needed.
    - Estimate should be broken down into at least three categories:
      - Cost to telescope and instrument hardware and design. This cost is unavoidable if parallel capability is required. This also includes any extra communications bandwidth needed to support a larger data rate (including the ground station).
      - Cost to develop an operations system capable of supporting parallel observations. Whether this is an up-front cost or not depends on the willingness to live with the delay in developing the software systems to support parallel observations only as the result of demonstrated need.

Parallel SI Calibration (cont)

- Remaining Issues (cont)
  - Cost to support parallel calibration observations. This includes any extra effort to create LRP and observation plan, handling the extra data volume, etc.

Observation Planning Process

Observation Planning Process

- Topic
  - The level of functionality or detail Principal Investigators will have in the observation specification process and when that information needs to be provided.
- Additional Issues
  - "Who can specify what" for an observation? (i.e What the observer can specify vs. what is specified by science operations?)
  - How do we mitigate the software development costs vs. the functionality needed for the planning process?
  - Should we limit the observation specification functionality to the observer in order to generate a more uniform dataset for the community at large?
  - What is the relationship between the contents of the phase 1 proposals, the TAC process, and the contents of the phase 2 programs?

Observation Planning Process (cont)

- Proposed Approach

  - NGST develops an integrated observation planning system that enables the following:
    - A single system to be used by NGST science and engineering operations.
    - Access by the observers to functions that are scientifically and technically justifiable.
    - Easy phase-in of capabilities to the observer as they become available.

Observation Planning Process(cont)

* Proposed Approach (cont.)

Sample list of capabilities available to a science observer

Observation specification	Method
Exposure Duration	Proposer specified
Orient - Phase 1	Proposer provides allowed orients or ranges of orients when scientifically justified.
Orient - Phase 2	Proposer is assigned an orient and has limited flexibility to adjust. (see other issues)
Dither Patterns	Proposer selects from set of pre-defined dither patterns.
Readout Modes	Proposer selects from allowed list.
Calibration	No GO Calibrations
Coordinated Parallels	No GO Coordinated Parallels
Guide Star Selection	See GS Selection Key issues section
Slit Position	Complete Specification: Proposer can select from all possible values.
Relative Timing (earlier targets - persistence)	Limited Specification: Proposer will be allowed to specify nominal time (units to be determined by operations) and a tolerance not less than an identified minimum.

Observation Planning Process(cont)

- Proposal process uses a phase 1, TAC, phase 2 approach.
  - Phase 1 will require a proposer to provide information on their observations for the purpose of TAC selection and generation of an initial LRP.
    - For spectrograph observations, an orient with some tolerance will be returned by the TAC process for phase 2.
  - Phase 2 will require a proposer to provide all details of an observation for S/C scheduling.
- Observers will be allowed to modify their information.
  - Observer can modify phase 1 information until the defined cycle deadline.
  - Observer can modify phase 2 information prior to Execution.
    - Level of change may be reduced as spacecraft execution approaches. (e.g. No changes allowed TBD hours prior to execution)

Observation Planning Process(cont)

- Advantages:
  - Direction of planning philosophy is consistent with the evolving HST operations scenario.
  - System will enable the implementation of functionality that considers the individual observer's needs vs. community at large.
  - Moving planning tasks to software used by observers enables a reduction of operations staff.

- Disadvantages:
  - May result in higher development and maintenance costs.

Observation Planning Process (Cont.)

- Remaining Issues
  - Need more discussion on when an initial LRP is generated.
  - Need to understand the ramifications on the LRP and scheduling that result from the identification of an orient value.
  - The variety of platforms used by the observation planning software may affect the software development process and its overall cost.

Guide Star Acquisition / Catalog

Guide Star Acquisition / Catalog

- GuidingTopic
  - What is the operational scenario for Guide Star selection?
- Guiding Additional Issues
  - The camera used for guiding may be lost for science observations
    - Science filter selection may not support guiding
    - NIRMOS observations using NIRCAM finder image also affected
      - At least 1/9 of the potential MOS field is lost for target selection
      - MOS followup observations are likely to have strongly desired orients to maximize field overlap
  - GS could fall in gap on one step of dither pattern
  - Could force increased involvement of the proposer in GS selection to allow science trades

Guide Star Acquisition / Catalog

- Guiding Assumptions
  - Guider is part of NIRCAM
  - Guiding will be done at <30Hz through R=5 filters, providing 92% probability of finding at least one guide star (for $\lambda < 2\ \mu m$) in a 16 $arcmin^2$ FOV.
  - Pre-selected Guide stars are needed for most observations to allow:
    - Verification that the field is correct
    - Precise centering to avoid detector gaps
  - Not supporting Guide Star Handoffs
  - Guide Star selection will be straight forward

Guide Star Acquisition (cont)

- Guiding Proposed Approach
  - STScI will generate a guide-star catalog suitable for most NGST observations.
  - GS selection is controlled by the observer with appropriate support from s/w.
  - Typical GS selection flow will be as follows:
    - Phase-1: Observer specifies acceptable roll ranges (as part of proposal to TAC).
    - Phase-2:
      - STScI notifies observer proposal has been accepted and gives observer roll angle (± a few degrees).
      - Observer selects exact roll, GS, spectrograph slit positions, dither pattern, etc. as part of phase-2 proposal.
  - Choice of filter for guiding is left to the observer (with guidance on how to optimize).

Guide Star Acquisition (cont)

- Guiding Trades
  - Advantages:
    - Simple two-phase proposal cycle
    - Acknowledges the fact that GS choice involves serious science tradeoffs with yardstick camera/guider configuration
    - STScI selection of actual orients allows schedule optimization.
  - Disadvantages:
    - Long-range plan needs to be laid out early.
    - Need to carry some “placeholder” spots for TOOs and to allow slop in computing overheads.
    - Need to determine calibration proposal scheduling requirements up front.
    - If many of the proposals do not have orient requirements, by telling the observers the orient and making them choose the GS, we decrease a potential avenue for scheduling flexibility.

Guide Star Acquisition (cont)

- Remaining Issues
  - Are multiple Guide Stars needed for the GS Acq process?
    - Reduces risk of GS Acq failure
  - Taking science data with the guiding camera should be supported if it is technically possible

Guide Star Acquisition (cont)

- GS Catalog Topic
  - Can we use GSC II as the NGST GS catalog?
- GS Catalog Additional Issues
  - Galaxy contamination could be much worse than for HST, given the fainter limiting magnitude.
  - Overlapping stars could also be much worse than for HST.
  - Special fields (e.g. globular clusters, bright stars) will require special GS catalogs to be constructed from shallower images.
  - At low galactic latitude & long wavelengths there could be a lot of spoilers.
  - Generally speaking, guiding at 5 μm from catalog information gathered at <0.8 μm is likely to be problematic.

Guide Star Acquisition (cont)

- Guide Star Catalog Assumptions
  - The core of the NGST GS catalog will be GSC II
    - Available by 2002
    - B_J,R,I bands
    - Limiting mags 20,21 in B_J,R, and 19.5 in I
    - Some gaps expected in Northern hemisphere and in special fields
    - Astrometric precision 0.2" rms in Hipparcos reference frame
  - GSC system allows straightforward filling of gaps from other materials (e.g. 2MASS, special plate scans).
- Summary
  - GSC II looks like it will satisfy most of the GS catalog requirements
  - All of the identified issues need more investigation

NGST Integration and Test Support

NGST Integration and Test Support

- Topic
  - What level of STScI involvement/support should be provided by STScI for various phases of integration and test?
  - To what extent should the ground system software support integration and test during these phases?

NGST Integration and Test Support(cont)

- Additional Issues
  - Early involvement and support of integration and test of NGST subsystems will
    - decrease overall mission cost and risk
    - increase early costs
  - Early development of ground system elements, as well as implementation of integration and test specific functionality, will
    - decrease overall mission cost and risk.
    - increase early costs
  - Distributed development of NGST adds risk that can be mitigated by a uniform integration and test approach.

NGST Integration and Test Support (cont)

- Proposed Approach
  - Develop ground system requirements for a common integration and test and mission operations center.
    - Identify requirements specific to the integration and test operations center.
  - Support all phases of spacecraft development by supporting integration and test of all flight software systems and key sub-systems:
    - Communications, Command & Data Handling, Attitude Control, Science Instrument, Spacecraft Bus (SSM), Payload Bus (ISIM), System Environment (NGST) and System Verification (NGST).
  - Develop ground system and flight software together.

NGST Integration and Test Support(cont)

- Trades
  - Advantages
    - The Mission Operations Team (MOT) is staffed early, and can bring an operations perspective to mission design decisions.
    - The MOT is actively involved in developing the command and telemetry database and in developing and executing spacecraft integration and test procedures.
    - The Flight Operations Team (FOT) will participate as integration and test engineers, in order to reduce risk by reducing the training time needed for the FOT as well as transfer the lessons learned from the I&T system to the mission operations system.
    - The experience the MOT gains with both the spacecraft and ground system will allow a smaller team to handle on-orbit operations, thereby reducing sustaining mission operations cost.

NGST Integration and Test Support(cont)

- The spacecraft engineers and scientists will also be trained using the ITOC system during System Integration and Test, so little additional training will be required when they come to the MOC for Launch and Early Operations.
- The common ground system will allow the command and telemetry database, displays and test procedures used in integration and test to be reused (with minor modifications) for on-orbit operations. This will also increase the reliability and maturity of the data base and procedures.
- The entire spacecraft development team will have access to all data from the spacecraft, from integration and test through operations.
  - Spacecraft anomaly recognition and diagnostic analysis will gain higher efficiency
  - Overall, program and schedule risk will be reduced.

NGST Integration and Test Support(cont)

- Disadvantages
  - Ensuring and managing involvement in all phases of integration and test for a distributed development is difficult
  - Cost of developing common integration and test and ground system can be hard to estimate.
    - Must be pessimistic about level of software reuse between systems, capabilities of COTS products, and difficulty of integration of COTS products.
    - Must be flexible in delivery of system for integration and test versus development of mission support requirements.
    - Develop one ground system for mission support with a few exceptions for integration and test.

NGST Integration and Test Support(cont)

- Key System Requirements
  - A single Mission Operations Team supports integration and test, launch preparation, and mission operations.
  - Ground System Requirements
    - Use of industry standards (TCP/IP, CCSDS) to reduce cost
    - Consistent and clear user interfaces that allow an inexperienced user to effectively use the system.
    - Command and telemetry databases can be changed, compiled and loaded quickly (within minutes).
    - Highly configurable, allowing multiple users to use the system in different ways simultaneously.
    - Permit users to access real-time or stored data independently, and to change access quickly.
    - Reliable in handling large amounts of data and high data rates over long periods of time.

NGST Integration and Test Support(cont)

- Conclusion
  - A substantial amount of time and cost can be saved by providing a single environment that meets the varied requirements of each phase of integration and test and mission operations.
  - Issues pertaining to STScI involvement in spacecraft development and operations need to be addressed w.r.t. overall STScI mission statement

Next Steps

- Annotate Table of Contents
  - Describe contents of each section
  - Describe how key issues are incorporated into various sections
  - Describe how special study reports are incorporated into various sections
- Continue investigation of remaining key issues
  - MOS specification and schedule
  - Parallels
  - Data processing
  - Archive
  - Flight Software
  - Proposal Cycle
  - Command Management

Process For Issuing The Document (cont)

- Write and edit document
  - Get key issues into the document.
  - Assign sections to members of working group for writing
  - Edit sections for content and consistency
  - Review initial and final draft
- Schedule For Generating The Document
  - Draft Version 1 - 8/11
  - Draft Version 2 - 9/15
  - Final - 9/29